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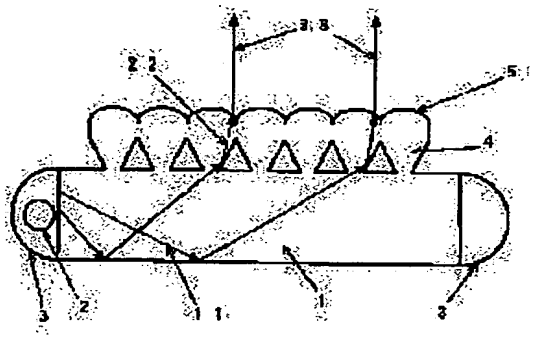
(71)Applicant : TORAY IND INC
(72)Inventor : UCHIDA TETSUO
SUZUKI MOTOYUKI
MIKAMI TOMOKO

(54) DIRECTIVE PLANAR LIGHT SOURCE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a planar light source effectively utilizing light beams and having thinly, uniformly high directivity, and high front face intensity by having a wall face of its tilted minutely small solid body in which an luminous flux captured in a minutely small solid body coming into close contact with a light guide plate surface is varied in its advancement within a given range with respect to a normal-line direction of the light guide plate surface and substantially paralleling that emitted light by a macro-lens.
SOLUTION: A minutely small solid body 4 is formed on a light guide plate 1, and a part of an luminous flux 11 is captured inside the minutely small solid body 4 from an optical introducing part. Amongst them, a strong luminous flux traveling at least inside the light guide plate 1 at an angle of 46 to 67 degrees is fully reflected on a wall face of the minutely small solid body, and the traveling direction is varied within a range of -20 to +20 degrees with respect to the normal-line direction. Further, this fully reflected luminous flux 22 is narrowed by a unit lens 5 comprising a micro-lens group formed on individual minutely small solid bodies 4, and a luminous flux 33 directed from the surface of the light guide plate 1 is substantially paralleled.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] In the source of sheet-like light where the array of a minute stereo was formed on the transparent light guide plate front face, and the linear light source has been arranged on at least 1 side face of this light guide plate The inside of the flux of light incorporated inside said minute stereo from photoconductive admission into a club of the minute stereo which repeated total reflection, ran within the light guide plate, and was stuck on said light guide plate front face, The flux of light which has the include angle of 46 - 67 degrees to the direction of a normal on the front face of a light guide plate at least It has the wall surface toward which said minute stereo which changes a travelling direction in the direction of within the limits of -20 - 20 degrees to the direction of a normal on the front face of a light guide plate by the total reflection in the wall surface toward which the minute stereo inclined inclined. The source of directive sheet-like light characterized by forming a micro lens in the optical outgoing radiation section of this minute stereo furthermore, and carrying out abbreviation parallel Guanghua of the outgoing radiation light from said minute stereo by this micro lens.
[Claim 2] The source of directive sheet-like light according to claim 1 where the tilt angle theta 2 of the wall surface toward which said minute stereo inclined is characterized by being 20 - 45 degrees.
[Claim 3] Said flux of light which carried out total reflection on said minute solid wall surface is a source of directive sheet-like light according to claim 1 or 2 characterized by being in the interior of the advance field of the flux of light when carrying out incidence to a micro lens from a normal on the front face of a light guide plate until it reaches a micro lens.
[Claim 4] The source of directive sheet-like light according to claim 1 to 3 where the array pitch of said micro-lens group is characterized by being 200 micrometers or less.
[Claim 5] The source of directive sheet-like light according to claim 1 to 4 where width of face of the photoconductive admission into a club which said minute stereo sticks optically with a light guide plate is characterized by being 1 / 6 - 1/2 of a lens array pitch.
[Claim 6] The source of directive sheet-like light according to claim 1 to 5 where the height of said minute stereo is characterized by being said 2.5 to 6 times photoconductive admission-into-a-club width of face.
[Claim 7] The source of directive sheet-like light according to claim 1 to 6 characterized by making it stick to a light guide plate as a sheet-like member which arranged said minute stereo on one field of a transparence substrate, and formed the micro lens in other fields of this transparence substrate.
[Claim 8] The source of directive sheet-like light according to claim 7 where said transparence substrate is characterized by being plastic film.
[Claim 9] The source of directive sheet-like light according to claim 8 where thickness of said plastic film is characterized by being 300 micrometers or less.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the source of directive sheet-like light.
[0002]
[Description of the Prior Art] Many sources of sheet-like light are used as a back light for liquid crystal displays besides a signboard and various lighting etc.
[0003] In order to secure the homogeneity of the brightness of a flux of light outgoing radiation side, the various diffusion plates which diffuse the flux of light at random are used for the general source of sheet-like light. For this reason, the flux of light by which outgoing radiation is carried out from this outgoing radiation side does not have directivity, and irradiates the large range.
[0004] On the other hand, extracting the direction of outgoing radiation of the flux of light to the narrow range depending on the application of the source of sheet-like light is called for.
[0005] for example, as an approach of improving the angle-of-visibility dependency it is undependable to the big hindrance of application expansion of a liquid crystal display Although equipping the observation side of a liquid crystal display with various optical diffusion sheets or micro-lens array sheets (a JP,53-25399,A official report, a JP,56-65175,A official report, a JP,61-148430,A official report, JP,6-27454,A official report, etc.) is proposed In these approaches, beam-of-light use effectiveness and the tooth-back light source in which an angle of divergence has the high directivity of 30 or less degrees for improvement in image quality (the fall of contrast and blot of an image) are useful.
[0006] The so-called louver sheet which put in order many protection-from-light walls extended along the travelling direction of the flux of light is known to this purpose.
[0007] According to the louver sheet, the source of sheet-like light with the directivity of arbitration is obtained by intercepting the flux of light which advances in addition to the direction which asks for what was the outgoing radiation light which has the breadth of 120 degrees or more, for example in an outgoing radiation side with a protection-from-light wall.
[0008] Moreover, in order to raise the brightness of the outgoing radiation side over power consumption as a back light for liquid crystal displays, the prism sheet which arranged many minute triangular prism is used, and this is attained by regulating the direction of the outgoing radiation of the flux of light to some extent.
[0009] According to this prism sheet, the directivity of about 60 degrees can be obtained depending on the optical design of the source of sheet-like light to combine, and prism, and transverse-plane brightness improves by about 1.5 times.
[0010] Furthermore, recently, the liquid crystal display is used for various game machines, a pachinko machine, etc., the outgoing radiation of the flux of light of high brightness is wanted to be carried out in the direction of a transverse plane in these applications, and the approach of raising transverse-plane brightness about 1.5 is applied, without changing power consumption with said prism sheet or a micro-lens array sheet also in these applications.
[0011]
[Problem(s) to be Solved by the Invention] However, the light source in which an angle of divergence has directivity, such as 40 or less degrees and 30 more degrees or less, without spoiling efficiently the "thinness" which is the description of the source of sheet-like light also in which the conventional approach was not acquired.
[0012] High directivity was not able to be obtained with the homogeneity within the "thinness" and beam-of-light use effectiveness which are searched for especially as a back light of a liquid crystal display, and a field secured.
[0013] According to the louver sheet, it is possible to obtain high directivity, as mentioned above. However, since a louver sheet needs to make in a sheet the protection-from-light wall extended in the thickness direction of a sheet, there is a limitation in the detailed-ization.
[0014] For this reason, if it is going to obtain high directivity, there is a fault that a protection-from-light wall inevitably "high", i.e., big sheet thickness, is needed.
[0015] Furthermore, since a limitation is in detailed-ization of a protection-from-light wall, the array of a protection-from-light wall is in sight as a back light of the close and viewed liquid crystal display, and there is a problem in respect of homogeneity and minute nature.
[0016] Moreover, since the flux of light which advances in addition to the direction to search for in the case of a louver sheet is absorbed with the protection-from-light wall, there is a fault that beam-of-light use effectiveness is low.

[0017] On the other hand, although high beam-of-light use effectiveness was acquired by the approach by the prism sheet, there was a limitation in the directivity, as mentioned above, about 60 degrees was a limitation, and the rate of the improvement in brightness was also about 1.5 times over the past.
[0018] Therefore, this invention cancels the above-mentioned fault, can use a beam of light efficiently, and it is thin, and it is uniform, and its directivity is high, and it offers the source of sheet-like light where transverse-plane brightness is very high.
[0019] The beam-of-light use degradation of a liquid crystal display with the angle of visibility expanded by equipping a liquid crystal display with an optical diffusibility sheet (a diffusion plate and micro-lens array sheet) which was especially mentioned above, In order to compensate problems, such as a fall of display contrast, and a blot of an image, the source of directive sheet-like light of a low power and the Takamasa side brightness is offered as an object for liquid crystal displays observed from [, such as an effective source of directive sheet-like light, and a game machine a pachinko machine,] a transverse plane.
[0020]
[Means for Solving the Problem] This invention is considered as the following configurations in order to solve the above-mentioned technical problem.
[0021] Namely, the array of a minute stereo is formed on a transparent light guide plate front face, and this invention is set in the source of sheet-like light where the linear light source has been arranged on at least 1 side face of this light guide plate. The inside of the flux of light incorporated inside said minute stereo from photoconductive admission into a club of the minute stereo which repeated total reflection, ran within the light guide plate, and was stuck on said light guide plate front face, The flux of light which has the include angle of 46 - 67 degrees to the direction of a normal on the front face of a light guide plate at least It has the wall surface toward which said minute stereo which changes a travelling direction in the direction of within the limits of -20 - 20 degrees to the direction of a normal on the front face of a light guide plate by the total reflection in the wall surface toward which the minute stereo inclined inclined. It is the source of directive sheet-like light characterized by forming a micro lens in the optical outgoing radiation section of this minute stereo furthermore, and carrying out abbreviation parallel Guanghua of the outgoing radiation light from said minute stereo by this micro lens.
[0022]
[Embodiment of the Invention] The thing of the source of sheet-like light which carries out outgoing radiation of the flux of light in which directivity had the source of directive sheet-like light of this invention to an observation side side is said.
[0023] Directivity here shall mean extent to which the travelling direction of the flux of light by which outgoing radiation is carried out from the source of sheet-like light is equal, and shall express the scissors angle of the solid angle by which one half of the brightness of the maximum brightness is observed centering on the direction where the highest brightness is observed as the scale here as an angle of beam spread.
[0024] The direction of outgoing radiation of the flux of light is near the direction of a normal, and, as for the directivity made into the purpose of this invention, the angle of beam spread has the high directivity of 40 or less degrees, 20 more degrees or less, and 10 more degrees or less.
[0025] Furthermore, in order that the source of directive sheet-like light of this invention may narrow down the flux of light in which outgoing radiation is carried out by the micro lens from a light guide plate, very high transverse-plane brightness is obtained compared with the conventional source of sheet-like light. In this case, power consumption does not become high in order to use the light source currently used for the conventional source of sheet-like light as it is. The transverse-plane brightness obtained in the source of directive sheet-like light of this invention is a very high thing of 3 or more times, further 4 or more times, and further 5 or more times compared with the conventional source of sheet-like light.
[0026] As an approach of giving directivity to the source of sheet-like light, as mentioned above, it makes for the source of directive sheet-like light of this invention to give directivity by the micro-lens group, although using a louver sheet and a prism sheet is known into a concept, and this invention is concretely explained using a mimetic diagram below.
[0027] The source of directive sheet-like light of this invention is the so-called source of edge type sheet-like light which has arranged the linear light source 2 on the side face of the transparent light guide plate 1 like drawing 1 .
[0028] Although the light guide plate 1 here says the thing of a transparent plastic sheet, it is represented with an acrylic resin plate, a polycarbonate plate, an epoxy resin plate, etc. and the configuration of a light guide plate is adjusted to a monotonous mold and wedge mold etc. in many cases, by this invention, the thing of a monotonous mold is preferably used from the ease of carrying out of beam-of-light path adjustment. Moreover, as for the thickness of this light guide plate 1, it is desirable that they are 10mm or less and 5 moremm or less from a thin shape and the point of being lightweight.
[0029] Moreover, as for especially the linear light source 2 here, it is desirable for it not to be limited, and for the fluorescent lamp of cold cathode or hot cathode etc. to be mentioned, for example, to surround the surroundings of this fluorescent lamp with the reflecting plate 3 with a high reflection factor (reflector), and to carry out incidence of the flux of light efficiently inside from light guide plate 1 side face. Any are sufficient as 1 side-face arrangement mold which especially the arrangement location of this linear light source 2 is not limited by this invention, and is arranged on one side face of a light guide plate 1 and the parallel 2 side-face arrangement mold arranged also on the side face of the opposite side, the L character mold 2 side-face arrangement mold arranged also on the side face which carried out the perpendicular to further 1 side face and its side face, the 4 side-face arrangement mold

arranged further altogether (four side faces).
[0030] The flux of light 11 exceeding the critical angle of reflection based on the refractive-index difference of the resin and the perimeter (fundamentally air) which constitute a light guide plate 1 among the flux of lights which are emitted from a linear light source 2 here, and trespass upon the light guide plate 1 interior from the side face of a light guide plate 1 repeats total reflection by the interface of a light guide plate 1 and air. The critical angle of reflection theta is searched for by the degree type here.
[0031] Theta=sin -1 (n1/n2)
n1: A surrounding refractive index (in the case of air 1.0)
n2: The critical angle of reflection of ******** of a light guide plate changes with the ingredient which constitutes a light guide plate 1, and surrounding matter, for example, when a light guide plate is acrylic resin (refractive index = 1.49) and a perimeter is air, the critical angle of reflection theta becomes about 42 degrees. Total reflection of them is carried out, all the flux of lights to which the include angle theta 1 of the flux of light which hits the interface of a light guide plate 1 and air among the flux of lights in a light guide plate 1 exceeds 42 critical angle of reflection when it is such conditions have light guide plate 1 smooth front face, and when it is plate-like, this theta 1 will not change, they will repeat total reflection within a light guide plate 1, and the flux of light does not carry out outgoing radiation from light guide plate 1 front face.
[0032] Since it is such, when a light guide plate 1 is an acrylic board, the flux of light which the flux of light which advances the inside of a light guide plate 1 is advancing at the include angle of 42 - 90 degrees to the direction of a normal of a light guide plate 1, and has the include angle of 46 - 67 degrees also in it according to this invention persons is the strongest.
[0033] Moreover, the source of directive sheet-like light of this invention makes the minute stereo 4 form on a light guide plate 1 like drawing 2 . A part of flux of light 11 which repeats total reflection within said light guide plate 1 is incorporated from photoconductive admission into a club to the minute solid 4 interior. Among these, total reflection of the strong flux of light which advances the inside of said light guide plate 1 at the include angle of 46 - 67 degrees at least is once carried out on the wall surface of a minute stereo. A travelling direction is changed within the limits of -20 - 20 degrees to the direction of a normal on the front face of a light guide plate. It narrows down with the unit lens 5 which constitutes the micro-lens group furthermore formed on each minute stereo 4 in this flux of light 22 that carried out total reflection, and is made to make it abbreviation parallel as the flux of light 33 orientation-ized from light guide plate 1 front face.
[0034] The unit lens 5 which constitutes the micro-lens group used for this invention is a convex lens like drawing 3 , and it is condensed, and the parallel light 44 which carried out [of the micro-lens group forming face] incidence to the unit lens 5 from the normal advances, being spread, after passing the condensing point 8 (it is a condensing line when it is a 1-dimensional micro-lens group) that luminous density becomes dense most.
[0035] If it sees from reverse, outgoing radiation of this flux of light path, the condensing path of said parallel light, and the flux of light 55 been [the flux of light / it] in agreement or approximated will be carried out in the direction of a normal of the formation of abbreviation parallel, i.e., a lens array side, as the flux of light 33 orientation-ized with the unit lens 5 among the flux of lights which carry out incidence from said condensing point 8 side (emitted).
[0036] The ideal configuration of the minute stereo which constitutes the source of directive sheet-like light of this invention, and a minute stereo is explained using drawing 4 .
[0037] An inclination is attached to the wall surface of the minute stereo 4 which arrives at the very first, i.e., a field distant in view of the linear light source 2 of the minute stereo 4, when the flux of light 11 which is emitted from a linear light source 2 at least, invades in a light guide plate 1 and advances is incorporated to the minute solid 4 interior, in order to carry out total reflection of the flux of light incorporated on the minute stereo 4 from the light guide plate 1 on minute solid 4 wall surface. You see the direction made to incline at this time from a linear light source 2, and it makes it incline in the distant direction. Moreover, as for a field 6, it is desirable from the point of efficiency for light utilization that it is parallel to a linear light source 2.
[0038] In order to carry out total reflection of the strong flux of light which advances the inside of the light guide plate 1 mentioned above at an angle of 46-67 effectively in respect of [6] said and to change the travelling direction after total reflection into the range of -20 - 20 degrees to the direction of a normal on the front face of a light guide plate, as for the tilt angle theta 2 of the field 6 of the minute stereo 4, it is desirable to consider as 20 - 45 degrees and further 25 - 35 degrees. Among the strong flux of lights of 46 - 67 degrees to which the tilt angle theta 2 advances the inside of a light guide plate 1 under by said range, since the flux of light does not reach the unit lens 5 which total reflection of the flux of light of a deep include angle cannot be carried out in respect of six, but penetrates this field 6, and corresponds, directivity falls sharply. Moreover, since it becomes impossible to carry out total reflection of the flux of light of a conversely shallow include angle in respect of six when said range is exceeded, it is not desirable. If it separates still more greatly from said range, since the flux of light path after total reflection shifts [of a light guide plate] from a normal, it is not desirable.
[0039] Moreover, the tilt angle theta 2 of the field 6 of this minute stereo 4 does not need to be a uniform include angle, for example, may be the shape of a field or a curved surface of the 2nd [or more] page from which a tilt angle differs. When a field 6 is a curved surface-like, this invention shall express the tilt angle theta 2 at the include angle of the tangent of a curved surface. When two or more fields which have the tilt angle from which such a field 6 differs exist, it is desirable to adjust so that the tilt angle of the field near the interface of a light guide plate and a minute stereo may be enlarged and the include angle of opposite Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. may become small in the height direction. It can consider as high efficiency for light utilization by carrying

out total reflection not only of said strong flux of light of 46 – 67 degrees but the flux of light incorporated inside a minute stereo from a light guide plate at the include angle beyond it once in respect of said large tilt angle, and reflecting this flux of light that carried out total reflection in respect of a small tilt angle by considering as such adjustment.

[0040] As for the width of face b of the unit lens 5 of the micro-lens group which constitutes the source of directive sheet-like light of this invention, it is desirable that it is 180 micrometers or less, and, as for the array pitch, it is desirable from points, such as homogeneity and minute nature, that it is 200 micrometers or less.

[0041] Moreover, as for the adhesion parts a of the minute stereo 4 and a light guide plate 1, i.e., the width of face of photoconductive admission into a club, it is desirable that it is 1 / 6 – 1/2, further 1 / 5 – 1/3 of the unit lens width of face b. Since the quantity of light which incorporates the flux of light 11 to which this photoconductive admission-into-a-club width of face a advances the inside of a light guide plate 1 under in said range to the minute solid 4 interior is too small, when it considers as the source of directive sheet-like light, since sufficient brightness is not obtained, it is not desirable. Moreover, since the quantity of light which carries out total reflection of the flux of light incorporated from about [that a part far from a linear light source becomes easy to serve as low brightness] and a light guide plate 1 although brightness with the very high part near a linear light source 2 was obtained when it considered as the source of directive sheet-like light, since the quantity of light which will be incorporated to the minute solid from light guide plate 1 4 interior if said range is exceeded was too large in respect of [6] said becomes less, it is not desirable.

[0042] As for height c of the minute stereo 4 of this invention, it is still more desirable that they are 2.5 to 6 times of said photoconductive admission-into-a-club width of face a and further three to 5 times. Since sufficient directivity is not obtained when the quantity of light height c of the minute stereo 4 carries out [the quantity of light] total reflection under in said range in respect of [6] said minute stereo 4 of the flux of light incorporated from the light guide plate 1 to the minute solid 4 interior becomes less and it considers as the source of directive sheet-like light, it is not desirable. Moreover, since the whole thickness becomes thick too much when said range was exceeded and it considers as the source of directive sheet-like light, it is not desirable.

[0043] It becomes possible to carry out total reflection of the great portion of flux of light incorporated from the light guide plate 1 to the minute solid 4 interior in respect of [6] said, and to adjust an advance path by considering as such a minute solid configuration. As for the quantity of light of this flux of light that carries out total reflection, it is desirable from the point of the use effectiveness of light that they are 70% or more which incorporated the flux of light which is advancing the inside of a light guide plate 1 at the include angle of 46 – 67 degrees of the quantity of light, 80 more% or more, and 90 more% or more.

[0044] The unit lens 5 which constitutes the micro-lens group formed on the minute stereo of the source of directive sheet-like light of this invention Incidence is carried out to the interior of a sheet at the include angle of 46 – 67 degrees like drawing 6 from the inside of the flux of light 1 which carried out total reflection in respect of [6] said, i.e., a light guide plate. By the time the flux of light by which total reflection was carried out in respect of [6] said, and the travelling direction was changed into –20 – 20 degrees of the direction of a normal of a light guide plate reaches the unit lens 5 It is desirable to adjust so that it may be located in the interior of the advance field of the flux of light 44 when carrying out [of a light guide plate 1] incidence to a micro lens from a normal (field of the shadow area A shown in drawing 6). Since directivity becomes low when a unit lens configuration and an array location do not fulfill said conditions, it is not desirable.

[0045] As an approach of making the minute stereo or micro-lens group which constitutes the source of directive sheet-like light of this invention forming on a light guide plate The female mold metal mold or the plastic pattern on which the desired minute stereo and the micro-lens pattern were stamped is prepared. Subsequently, it is filled up with transparent thermosetting or ultraviolet rays, and electron ray hardenability resin into this mold, and doubles on a light guide plate. The method of making the minute stereo and micro-lens group other than the approach of making this resin harden form on the transparence substrate 7 beforehand, and making a minute stereo and a light guide plate stick optically is also preferably applied like drawing 5 . When applying such an approach, although a minute stereo may form a micro-lens group in the field of the opposite side of the field in which the one where width of face is narrower was turned up, it was formed on the transparence substrate, and the minute stereo of a transparence substrate was formed and may exfoliate a light guide plate and the transparence substrate after adhesion in a minute solid crowning, even when it remains as it is, it is good.

[0046] As for the transparence substrate used by this invention, it is desirable that it is plastic film from points, such as a mechanical strength, and it is desirable that the thickness is 300 micrometers or less further in respect of a thin shape.

[0047] The minute solid inclined plane (field 6) which the configuration of a minute stereo and the array condition mentioned above in the location parallel to the linear light source which was adjusted and has been arranged on the light guide plate side face is arranged by the location where the minute stereo which constitutes the source of directive sheet-like light of this invention arranges a linear light source. When the linear light source has been arranged on one side face or another side face (2 side-face arrangement) parallel to the side face and the linear light source has been arranged on the shape of one-dimensional array or two-dimensional array, and L character, and four side faces, two-dimensional array is taken. In addition, the boiled-fish-paste-like lens (the so-called cylindrical lens) etc. was formed, it functions only on right and left or a vertical one direction as a lens, as for two-dimensional array, the lens was formed at configurations, such as the shape of a dome, and the one-dimensional array of a minute stereo functions as a lens to the 2-way of the upper and lower sides and right and left at least.

[0048]
[Example] Hereafter, although this invention is explained in detail according to an example, it is not restricted to this.

[0049] The metal mold on which the configuration for which the whole surface of polyester film ("lumiler" Toray Industries, Inc. make) with an example [1] - a 3 thickness of 38 micrometers is asked was stamped was filled up with acrylic ultraviolet curing mold resin (refractive index 1.50), ultraviolet rays were irradiated, and one-dimensional array of the minute stereo as shown in drawing 6 (configuration) and Table 1 (dimension) was carried out by exfoliating metal mold. The metal mold on which the configuration similarly searched for was stamped was filled up with ultraviolet curing mold resin, and UV irradiation and the micro-lens group by which the unit lens of the condensing point distance shown in drawing 6 and Table 1 by carrying out metal mold exfoliation in the field of the opposite side of a minute stereo was arranged were made to form about examples 1-3 in this. The condensing path of the parallel light which carries out incidence from the lens forming face side of the unit lens which constitutes this micro-lens group at this time performed alignment so that the inclined plane of a minute stereo might be hit.
[0050] Next, the light guide plate of the example of this invention and the example of a comparison was created by sticking a minute solid crowning on an acrylic resin plate front face optically, as the thickness of 4mm and the acrylic resin plate of a 67mm long and 81mm wide monotonous mold are prepared and the side face in which a linear light source is arranged below, and the inclined plane 6 of said minute stereo become parallel.
[0051] What carried the prism sheet for the conventional source of sheet-like light to which the diffusion plate was taken on the light guide plate which performed mat processing to said acrylic board front face further the example 1 of a comparison and on it was prepared as an example 2 of a comparison as the example 1 of a comparison, and a source of sheet-like light of 2 former.
[0052] [Optical property evaluation] The direction where the linear light source (2W fluorescent lamp use) has been arranged on one side face of said light guide plate, other side faces were equipped with the reflecting plate, the direction of a normal of a light guide plate was made into 0 times, and the linear light source has been arranged was considered as plus (+), the opposite side was considered as minus (-), the brightness according to include angle of the flux of light by which outgoing radiation is carried out measured, and the include angle (peak angle) at which the maximum brightness be observed, the maximum brightness, and an angle of beam spread be shown in Table 2.
[0053] The source of sheet-like light using the light guide plate of the example of Table 2 this invention is understood that transverse-plane brightness and directivity are very high compared with the conventional thing.
[0054]
[Table 1]

	a (μm)	b (μm)	c (μm)	d (μm)	θ2 (deg)	レンズ集光点距離 (μm)
実施例1	10	60	30	27	30	60
実施例2	5	30	15	14	33	30
実施例3	10	62	40	38	35	75

[Table 2]

	ピーク角 (deg)	最大輝度 (cd/m²)	指向角 (deg)	備考
実施例1	2	12300	4	
実施例2	0	12000	6	
実施例3	0	13200	4	
比較例1	13	1800	60<	従来品
比較例2	6	2300	62	従来品／プリズムシート装着

[0055]
[Effect of the Invention] By using a beam of light efficiently, without raising the power consumption of the conventional source of sheet-like light It is thin, and is uniform and the source of sheet-like light of high directivity and the Takamasa side brightness can be offered. In order to compensate problems, such as a transverse-plane brightness fall of a liquid crystal display with the angle of visibility expanded by equipping a liquid crystal display especially with an optical diffusibility sheet (a diffusion plate and micro-lens array sheet), a fall of display contrast, and a blot of an image, the effective source of directive sheet-like light can be offered.
[0056] The source of thing directivity sheet-like light where transverse-plane brightness is high can be offered with the liquid crystal display furthermore observed from a transverse plane in many cases, for example, a personal computer, car navigation, a game, and a low power effective in the liquid crystal display for pachinko.

[Translation done.]

* NOTICES *

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3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] This invention relates to the source of directive sheet-like light.

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PRIOR ART

[Description of the Prior Art] Many sources of sheet-like light are used as a back light for liquid crystal displays besides a signboard and various lighting etc.
[0003] In order to secure the homogeneity of the brightness of a flux of light outgoing radiation side, the various diffusion plates which diffuse the flux of light at random are used for the general source of sheet-like light. For this reason, the flux of light by which outgoing radiation is carried out from this outgoing radiation side does not have directivity, and irradiates the large range.
[0004] On the other hand, extracting the direction of outgoing radiation of the flux of light to the narrow range depending on the application of the source of sheet-like light is called for.
[0005] As the approach of improving the angle-of-visibility dependency it is undependable to the big hindrance of application expansion of a liquid crystal display, Although equipping the observation side of a liquid crystal display with various optical diffusion sheets or micro-lens array sheets (a JP,53-25399,A official report, a JP,56-65175,A official report, a JP,61-148430,A official report, JP,6-27454,A official report, etc.) be propose, in these approaches, beam-of-light use effectiveness and the tooth-back light source in which an angle of divergence have the high directivity of 30 or less degrees for improvement in image quality (the fall of contrast and blot of an image) be useful.
[0006] The so-called louver sheet which put in order many protection-from-light walls extended along the travelling direction of the flux of light is known to this purpose.
[0007] According to the louver sheet, the source of sheet-like light with the directivity of arbitration is obtained by intercepting the flux of light which advances in addition to the direction which asks for what was the outgoing radiation light which has the breadth of 120 degrees or more, for example in an outgoing radiation side with a protection-from-light wall.
[0008] Moreover, in order to raise the brightness of the outgoing radiation side over power consumption as a back light for liquid crystal displays, the prism sheet which arranged many minute triangular prism is used, and this is attained by regulating the direction of the outgoing radiation of the flux of light to some extent.
[0009] According to this prism sheet, the directivity of about 60 degrees can be obtained depending on the optical design of the source of sheet-like light to combine, and prism, and transverse-plane brightness improves by about 1.5 times.
[0010] Furthermore, recently, the liquid crystal display is used for various game machines, a pachinko machine, etc., the outgoing radiation of the flux of light of high brightness is wanted to be carried out in the direction of a transverse plane in these applications, and the approach of raising transverse-plane brightness about 1.5 is applied, without changing power consumption with said prism sheet or a micro-lens array sheet also in these applications.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] In order to compensate problems, such as a transverse-plane brightness fall of a liquid crystal display with the angle of visibility expanded by it being thin, being uniform, being able to offer the source of sheet-like light of high directivity and the Takamasa side brightness, and equipping a liquid crystal display especially with an optical diffusibility sheet (a diffusion plate and micro-lens array sheet) by using a beam of light efficiently, a fall of display contrast, and a blot of an image, without raising the power consumption of the conventional source of sheet-like light The effective source of directive sheet-like light can be offered.
[0056] The source of thing directivity sheet-like light where transverse-plane brightness is high can be offered with the liquid crystal display furthermore observed from a transverse plane in many cases, for example, a personal computer, car navigation, a game, and a low power effective in the liquid crystal display for pachinko.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the light source in which an angle of divergence has directivity, such as 40 or less degrees and 30 more degrees or less, without spoiling efficiently the "thinness" which is the description of the source of sheet-like light also in which the conventional approach was not acquired.
[0012] High directivity was not able to be obtained with the homogeneity within the "thinness" and beam-of-light use effectiveness which are searched for especially as a back light of a liquid crystal display, and a field secured.
[0013] According to the louver sheet, it is possible to obtain high directivity, as mentioned above. However, since a louver sheet needs to make in a sheet the protection-from-light wall extended in the thickness direction of a sheet, there is a limitation in the detailed-ization.
[0014] For this reason, if it is going to obtain high directivity, there is a fault that a protection-from-light wall inevitably "high", i.e., big sheet thickness, is needed.
[0015] Furthermore, since a limitation is in detailed-ization of a protection-from-light wall, the array of a protection-from-light wall is in sight as a back light of the close and viewed liquid crystal display, and there is a problem in respect of homogeneity and minute nature.
[0016] Moreover, since the flux of light which advances in addition to the direction to search for in the case of a louver sheet is absorbed with the protection-from-light wall, there is a fault that beam-of-light use effectiveness is low.
[0017] On the other hand, although high beam-of-light use effectiveness was acquired by the approach by the prism sheet, there was a limitation in the directivity, as mentioned above, about 60 degrees was a limitation, and the rate of the improvement in brightness was also about 1.5 times over the past.
[0018] Therefore, this invention cancels the above-mentioned fault, can use a beam of light efficiently, and it is thin, and it is uniform, and its directivity is high, and it offers the source of sheet-like light where transverse-plane brightness is very high.
[0019] The beam-of-light use degradation of a liquid crystal display with the angle of visibility expanded by equipping a liquid crystal display with an optical diffusibility sheet (a diffusion plate and micro-lens array sheet) which was especially mentioned above, In order to compensate problems, such as a fall of display contrast, and a blot of an image, the source of directive sheet-like light of a low power and the Takamasa side brightness is offered as an object for liquid crystal displays observed from [, such as an effective source of directive sheet-like light, and a game machine a pachinko machine,] a transverse plane.

[Translation done.]

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MEANS

[Means for Solving the Problem] This invention is considered as the following configurations in order to solve the above-mentioned technical problem.
[0021] Namely, the array of a minute stereo is formed on a transparent light guide plate front face, and this invention is set in the source of sheet-like light where the linear light source has been arranged on at least 1 side face of this light guide plate. The inside of the flux of light incorporated inside said minute stereo from photoconductive admission into a club of the minute stereo which repeated total reflection, ran within the light guide plate, and was stuck on said light guide plate front face, The flux of light which has the include angle of 46 - 67 degrees to the direction of a normal on the front face of a light guide plate at least It has the wall surface toward which said minute stereo which changes a travelling direction in the direction of within the limits of -20 - 20 degrees to the direction of a normal on the front face of a light guide plate by the total reflection in the wall surface toward which the minute stereo inclined inclined. It is the source of directive sheet-like light characterized by forming a micro lens in the optical outgoing radiation section of this minute stereo furthermore, and carrying out abbreviation parallel Guanghua of the outgoing radiation light from said minute stereo by this micro lens.
[0022]
[Embodiment of the Invention] The thing of the source of sheet-like light which carries out outgoing radiation of the flux of light in which directivity had the source of directive sheet-like light of this invention to an observation side side is said.
[0023] Directivity here shall mean extent to which the travelling direction of the flux of light by which outgoing radiation is carried out from the source of sheet-like light is equal, and shall express the scissors angle of the solid angle by which one half of the brightness of the maximum brightness is observed centering on the direction where the highest brightness is observed as the scale here as an angle of beam spread.
[0024] The direction of outgoing radiation of the flux of light is near the direction of a normal, and, as for the directivity made into the purpose of this invention, the angle of beam spread has the high directivity of 40 or less degrees, 20 more degrees or less, and 10 more degrees or less.
[0025] Furthermore, in order that the source of directive sheet-like light of this invention may narrow down the flux of light in which outgoing radiation is carried out by the micro lens from a light guide plate, very high transverse-plane brightness is obtained compared with the conventional source of sheet-like light. In this case, power consumption does not become high in order to use the light source currently used for the conventional source of sheet-like light as it is. The transverse-plane brightness obtained in the source of directive sheet-like light of this invention is a very high thing of 3 or more times, further 4 or more times, and further 5 or more times compared with the conventional source of sheet-like light.
[0026] As an approach of giving directivity to the source of sheet-like light, as mentioned above, it makes for the source of directive sheet-like light of this invention to give directivity by the micro-lens group, although using a louver sheet and a prism sheet is known into a concept, and this invention is concretely explained using a mimetic diagram below.
[0027] The source of directive sheet-like light of this invention is the so-called source of edge type sheet-like light which has arranged the linear light source 2 on the side face of the transparent light guide plate 1 like drawing 1 .
[0028] Although the light guide plate 1 here says the thing of a transparent plastic sheet, it is represented with an acrylic resin plate, a polycarbonate plate, an epoxy resin plate, etc. and the configuration of a light guide plate is adjusted to a monotonous mold and wedge mold etc. in many cases, by this invention, the thing of a monotonous mold is preferably used from the ease of carrying out of beam-of-light path adjustment. Moreover, as for the thickness of this light guide plate 1, it is desirable that they are 10mm or less and 5 moremm or less from a thin shape and the point of being lightweight.
[0029] Moreover, as for especially the linear light source 2 here, it is desirable for it not to be limited, and for the fluorescent lamp of cold cathode or hot cathode etc. to be mentioned, for example, to surround the surroundings of this fluorescent lamp with the reflecting plate 3 with a high reflection factor (reflector), and to carry out incidence of the flux of light efficiently inside from light guide plate 1 side face. Any are sufficient as 1 side-face arrangement mold which especially the arrangement location of this linear light source 2 is not limited by this invention, and is arranged on one side face of a light guide plate 1 and the parallel 2 side-face arrangement mold arranged also on the side face of the opposite side, the L character mold 2 side-face arrangement mold arranged also on the side face which carried out the perpendicular to further 1 side face and its side face, the 4 side-face arrangement mold arranged further altogether (four side faces).

[0030] The flux of light 11 exceeding the critical angle of reflection based on the refractive-index difference of the resin and the perimeter (fundamentally air) which constitute a light guide plate 1 among the flux of lights which are emitted from a linear light source 2 here, and trespass upon the light guide plate 1 interior from the side face of a light guide plate 1 repeats total reflection by the interface of a light guide plate 1 and air. The critical angle of reflection theta is searched for by the degree type here.
[0031] Theta=sin -1 (n1/n2)
n1: A surrounding refractive index (in the case of air 1.0)
n2: The critical angle of reflection of ******** of a light guide plate changes with the ingredient which constitutes a light guide plate 1, and surrounding matter, for example, when a light guide plate is acrylic resin (refractive index = 1.49) and a perimeter is air, the critical angle of reflection theta becomes about 42 degrees. Total reflection of them is carried out, all the flux of lights to which the include angle theta 1 of the flux of light which hits the interface of a light guide plate 1 and air among the flux of lights in a light guide plate 1 exceeds 42 critical angle of reflection when it is such conditions have light guide plate 1 smooth front face, and when it is plate-like, this theta 1 will not change, they will repeat total reflection within a light guide plate 1, and the flux of light does not carry out outgoing radiation from light guide plate 1 front face.
[0032] Since it is such, when a light guide plate 1 is an acrylic board, the flux of light which the flux of light which advances the inside of a light guide plate 1 is advancing at the include angle of 42 - 90 degrees to the direction of a normal of a light guide plate 1, and has the include angle of 46 - 67 degrees also in it according to this invention persons is the strongest.
[0033] Moreover, the source of directive sheet-like light of this invention makes the minute stereo 4 form on a light guide plate 1 like drawing 2 . A part of flux of light 11 which repeats total reflection within said light guide plate 1 is incorporated from photoconductive admission into a club to the minute solid 4 interior. Among these, total reflection of the strong flux of light which advances the inside of said light guide plate 1 at the include angle of 46 - 67 degrees at least is once carried out on the wall surface of a minute stereo. A travelling direction is changed within the limits of -20 - 20 degrees to the direction of a normal on the front face of a light guide plate. It narrows down with the unit lens 5 which constitutes the micro-lens group furthermore formed on each minute stereo 4 in this flux of light 22 that carried out total reflection, and is made to make it abbreviation parallel as the flux of light 33 orientation-ized from light guide plate 1 front face.
[0034] The unit lens 5 which constitutes the micro-lens group used for this invention is a convex lens like drawing 3 , and it is condensed, and the parallel light 44 which carried out [of the micro-lens group forming face] incidence to the unit lens 5 from the normal advances, being spread, after passing the condensing point 8 (it is a condensing line when it is a 1-dimensional micro-lens group) that luminous density becomes dense most.
[0035] If it sees from reverse, outgoing radiation of this flux of light path, the condensing path of said parallel light, and the flux of light 55 been [the flux of light / it] in agreement or approximated will be carried out in the direction of a normal of the formation of abbreviation parallel, i.e., a lens array side, as the flux of light 33 orientation-ized with the unit lens 5 among the flux of lights which carry out incidence from said condensing point 8 side (emitted).
[0036] The ideal configuration of the minute stereo which constitutes the source of directive sheet-like light of this invention, and a minute stereo is explained using drawing 4 .
[0037] An inclination is attached to the wall surface of the minute stereo 4 which arrives at the very first, i.e., a field distant in view of the linear light source 2 of the minute stereo 4, when the flux of light 11 which is emitted from a linear light source 2 at least, invades in a light guide plate 1 and advances is incorporated to the minute solid 4 interior, in order to carry out total reflection of the flux of light incorporated on the minute stereo 4 from the light guide plate 1 on minute solid 4 wall surface. You see the direction made to incline at this time from a linear light source 2, and it makes it incline in the distant direction. Moreover, as for a field 6, it is desirable from the point of efficiency for light utilization that it is parallel to a linear light source 2.
[0038] In order to carry out total reflection of the strong flux of light which advances the inside of the light guide plate 1 mentioned above at an angle of 46-67 effectively in respect of [6] said and to change the travelling direction after total reflection into the range of -20 - 20 degrees to the direction of a normal on the front face of a light guide plate, as for the tilt angle theta 2 of the field 6 of the minute stereo 4, it is desirable to consider as 20 - 45 degrees and further 25 - 35 degrees. Among the strong flux of lights of 46 - 67 degrees to which the tilt angle theta 2 advances the inside of a light guide plate 1 under by said range, since the flux of light does not reach the unit lens 5 which total reflection of the flux of light of a deep include angle cannot be carried out in respect of six, but penetrates this field 6, and corresponds, directivity falls sharply. Moreover, since it becomes impossible to carry out total reflection of the flux of light of a conversely shallow include angle in respect of six when said range is exceeded, it is not desirable. If it separates still more greatly from said range, since the flux of light path after total reflection shifts [of a light guide plate] from a normal, it is not desirable.
[0039] Moreover, the tilt angle theta 2 of the field 6 of this minute stereo 4 does not need to be a uniform include angle, for example, may be the shape of a field or a curved surface of the 2nd [or more] page from which a tilt angle differs. When a field 6 is a curved surface-like, this invention shall express the tilt angle theta 2 at the include angle of the tangent of a curved surface. When two or more fields which have the tilt angle from which such a field 6 differs exist, it is desirable to adjust so that the tilt angle of the field near the interface of a light guide plate and a minute stereo may be enlarged and the include angle of opposite Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne. may become small in the height direction. It can consider as high efficiency for light utilization by carrying out total reflection not only of said strong flux of light of 46 - 67 degrees but the flux of light incorporated inside a

minute stereo from a light guide plate at the include angle beyond it once in respect of said large tilt angle, and reflecting this flux of light that carried out total reflection in respect of a small tilt angle by considering as such adjustment.

[0040] As for the width of face b of the unit lens 5 of the micro-lens group which constitutes the source of directive sheet-like light of this invention, it is desirable that it is 180 micrometers or less, and, as for the array pitch, it is desirable from points, such as homogeneity and minute nature, that it is 200 micrometers or less.

[0041] Moreover, as for the adhesion parts a of the minute stereo 4 and a light guide plate 1, i.e., the width of face of photoconductive admission into a club, it is desirable that it is 1 / 6 - 1/2, further 1 / 5 - 1/3 of the unit lens width of face b. Since the quantity of light which incorporates the flux of light 11 to which this photoconductive admission-into-a-club width of face a advances the inside of a light guide plate 1 under in said range to the minute solid 4 interior is too small, when it considers as the source of directive sheet-like light, since sufficient brightness is not obtained, it is not desirable. Moreover, since the quantity of light which carries out total reflection of the flux of light incorporated from about [that a part far from a linear light source becomes easy to serve as low brightness] and a light guide plate 1 although brightness with the very high part near a linear light source 2 was obtained when it considered as the source of directive sheet-like light, since the quantity of light which will be incorporated to the minute solid from light guide plate 1 4 interior if said range is exceeded was too large in respect of [6] said becomes less, it is not desirable.

[0042] As for height c of the minute stereo 4 of this invention, it is still more desirable that they are 2.5 to 6 times of said photoconductive admission-into-a-club width of face a and further three to 5 times. Since sufficient directivity is not obtained when the quantity of light height c of the minute stereo 4 carries out [the quantity of light] total reflection under in said range in respect of [6] said minute stereo 4 of the flux of light incorporated from the light guide plate 1 to the minute solid 4 interior becomes less and it considers as the source of directive sheet-like light, it is not desirable. Moreover, since the whole thickness becomes thick too much when said range was exceeded and it considers as the source of directive sheet-like light, it is not desirable.

[0043] It becomes possible to carry out total reflection of the great portion of flux of light incorporated from the light guide plate 1 to the minute solid 4 interior in respect of [6] said, and to adjust an advance path by considering as such a minute solid configuration. As for the quantity of light of this flux of light that carries out total reflection, it is desirable from the point of the use effectiveness of light that they are 70% or more which incorporated the flux of light which is advancing the inside of a light guide plate 1 at the include angle of 46 - 67 degrees of the quantity of light, 80 more% or more, and 90 more% or more.

[0044] The unit lens 5 which constitutes the micro-lens group formed on the minute stereo of the source of directive sheet-like light of this invention Incidence is carried out to the interior of a sheet at the include angle of 46 - 67 degrees like drawing 6 from the inside of the flux of light 1 which carried out total reflection in respect of [6] said, i.e., a light guide plate. By the time the flux of light by which total reflection was carried out in respect of [6] said, and the travelling direction was changed into -20 - 20 degrees of the direction of a normal of a light guide plate reaches the unit lens 5 It is desirable to adjust so that it may be located in the interior of the advance field of the flux of light 44 when carrying out [of a light guide plate 1] incidence to a micro lens from a normal (field of the shadow area A shown in drawing 6). Since directivity becomes low when a unit lens configuration and an array location do not fulfill said conditions, it is not desirable.

[0045] As an approach of making the minute stereo or micro-lens group which constitutes the source of directive sheet-like light of this invention forming on a light guide plate The female mold metal mold or the plastic pattern on which the desired minute stereo and the micro-lens pattern were stamped is prepared. Subsequently, it is filled up with transparent thermosetting or ultraviolet rays, and electron ray hardenability resin into this mold, and doubles on a light guide plate. The method of making the minute stereo and micro-lens group other than the approach of making this resin harden form on the transparence substrate 7 beforehand, and making a minute stereo and a light guide plate stick optically is also preferably applied like drawing 5 . When applying such an approach, although a minute stereo may form a micro-lens group in the field of the opposite side of the field in which the one where width of face is narrower was turned up, it was formed on the transparence substrate, and the minute stereo of a transparence substrate was formed and may exfoliate a light guide plate and the transparence substrate after adhesion in a minute solid crowning, even when it remains as it is, it is good.

[0046] As for the transparence substrate used by this invention, it is desirable that it is plastic film from points, such as a mechanical strength, and it is desirable that the thickness is 300 micrometers or less further in respect of a thin shape.

[0047] The minute solid inclined plane (field 6) which the configuration of a minute stereo and the array condition mentioned above in the location parallel to the linear light source which was adjusted and has been arranged on the light guide plate side face is arranged by the location where the minute stereo which constitutes the source of directive sheet-like light of this invention arranges a linear light source. When the linear light source has been arranged on one side face or another side face (2 side-face arrangement) parallel to the side face and the linear light source has been arranged on the shape of one-dimensional array or two-dimensional array, and L character, and four side faces, two-dimensional array is taken. In addition, the boiled-fish-paste-like lens (the so-called cylindrical lens) etc. was formed, it functions only on right and left or a vertical one direction as a lens, as for two-dimensional array, the lens was formed at configurations, such as the shape of a dome, and the one-dimensional array of a minute stereo functions as a lens to the 2-way of the upper and lower sides and right and left at least.

EXAMPLE

[Example] Hereafter, although this invention is explained in detail according to an example, it is not restricted to this.

[0049] The metal mold on which the configuration for which the whole surface of polyester film ("lumiler" Toray Industries, Inc. make) with an example [1] - a 3 thickness of 38 micrometers is asked was stamped was filled up with acrylic ultraviolet curing mold resin (refractive index 1.50), ultraviolet rays were irradiated, and one-dimensional array of the minute stereo as shown in drawing 6 (configuration) and Table 1 (dimension) was carried out by exfoliating metal mold. The metal mold on which the configuration similarly searched for was stamped was filled up with ultraviolet curing mold resin, and UV irradiation and the micro-lens group by which the unit lens of the condensing point distance shown in drawing 6 and Table 1 by carrying out metal mold exfoliation in the field of the opposite side of a minute stereo was arranged were made to form about examples 1-3 in this. The condensing path of the parallel light which carries out incidence from the lens forming face side of the unit lens which constitutes this micro-lens group at this time performed alignment so that the inclined plane of a minute stereo might be hit.
[0050] Next, the light guide plate of the example of this invention and the example of a comparison was created by sticking a minute solid crowning on an acrylic resin plate front face optically, as the thickness of 4mm and the acrylic resin plate of a 67mm long and 81mm wide monotonous mold are prepared and the side face in which a linear light source is arranged below, and the inclined plane 6 of said minute stereo become parallel.
[0051] What carried the prism sheet for the conventional source of sheet-like light to which the diffusion plate was taken on the light guide plate which performed mat processing to said acrylic board front face further the example 1 of a comparison and on it was prepared as an example 2 of a comparison as the example 1 of a comparison, and a source of sheet-like light of 2 former.
[0052] [Optical property evaluation] The direction where the linear light source (2W fluorescent lamp use) has been arranged on one side face of said light guide plate, other side faces were equipped with the reflecting plate, the direction of a normal of a light guide plate was made into 0 times, and the linear light source has been arranged was considered as plus (+), the opposite side was considered as minus (-), the brightness according to include angle of the flux of light by which outgoing radiation is carried out measured, and the include angle (peak angle) at which the maximum brightness be observed, the maximum brightness, and an angle of beam spread be shown in Table 2.
[0053] The source of sheet-like light using the light guide plate of the example of Table 2 this invention is understood that transverse-plane brightness and directivity are very high compared with the conventional thing.
[0054]
[Table 1]

	a (μm)	b (μm)	c (μm)	d (μm)	θ2 (deg)	レンズ集光点距離 (μm)
実施例1	10	60	30	27	30	60
実施例2	6	30	15	14	33	30
実施例3	10	62	40	38	35	75

[Table 2]

	ピーク角 (deg)	最大輝度 (cd/m²)	指向角 (deg)	備考
実施例1	2	12300	4	
実施例2	0	12000	6	
実施例3	0	13200	4	
比較例1	13	1800	60<	従来品
比較例2	6	2300	62	従来品／プリズムシート装着

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram showing an example of the source of directive sheet-like light.
[Drawing 2] It is the schematic diagram showing an example of the source of directive sheet-like light of this invention.
[Drawing 3] It is the explanatory view showing an example of the micro-lens group which constitutes the source of directive sheet-like light of this invention.
[Drawing 4] It is the explanatory view showing other examples of the source of directive sheet-like light of this invention.
[Drawing 5] It is the explanatory view showing an example of the method of creating the source of directive sheet-like light of this invention.
[Drawing 6] It is the mimetic diagram of the configuration of the minute stereo used for the example and the example of a comparison of this invention.
[Description of Notations]
1: Light guide plate
2: Linear light source
3: Reflector
4: Minute stereo
5: Unit lens
6: Minute solid wall surface
7: Transparence substrate
8: The condensing point of the parallel light which carries out incidence to a unit lens from a lens forming face side
a: Photoconductive admission-into-a-club part width of face
b: Unit lens width of face
c: Minute solid height
d: Minute solid width of face
e: Condensing point distance of the parallel light which carries out incidence to a unit lens from a lens forming face side
11: The flux of light which advances the inside of a light guide plate
22: The flux of light which carried out minute solid wall surface total reflection
33: The flux of light orientation-ized by the micro lens
44: Parallel light which carries out incidence from a micro-lens forming face side
The flux of light which carries out incidence to a micro lens from the condensing point side of 55:44 light
theta 1: The include angle of the flux of light which advances the inside of a light guide plate
theta 2: The tilt angle of the interface 6 of a minute stereo and air

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[Translation done.]

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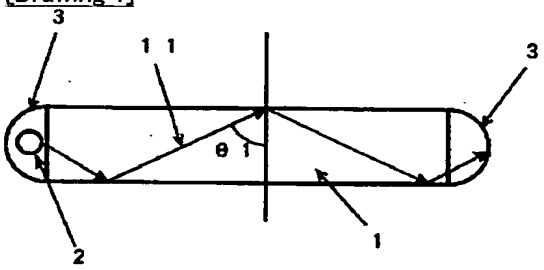
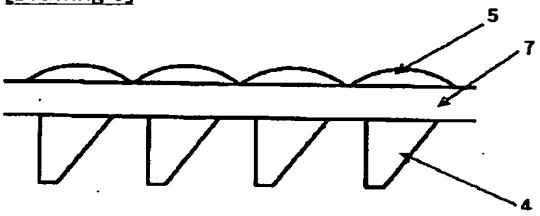
DRAWINGS

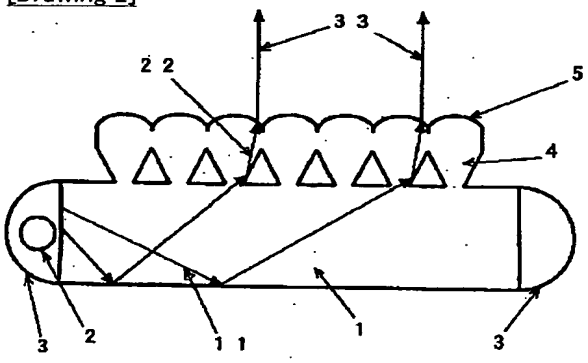
[Drawing 1]



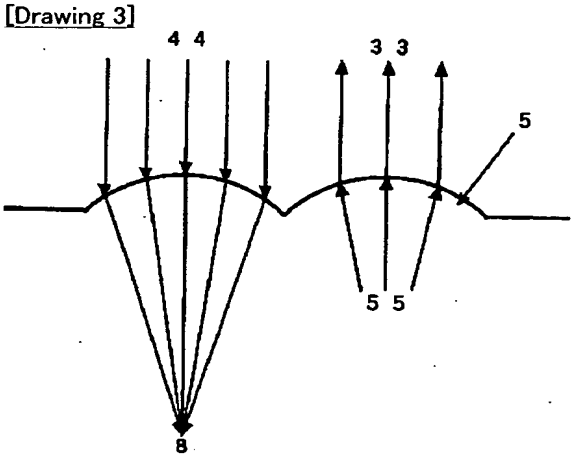
[Drawing 5]



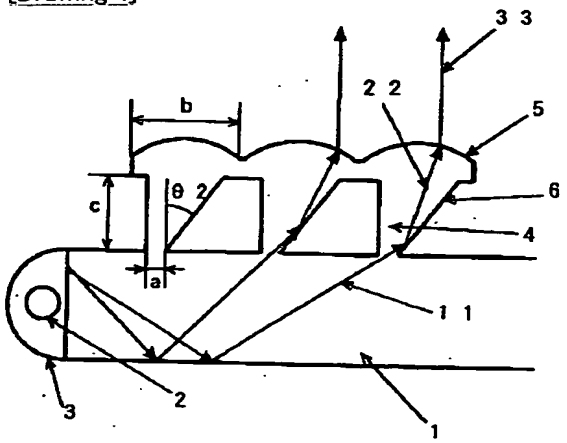
[Drawing 2]



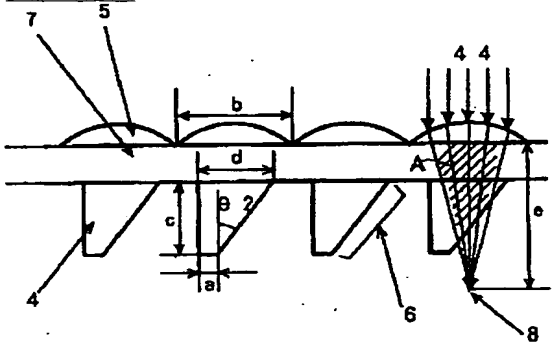
[Drawing 3]



[Drawing 4]



[Drawing 6]



[Translation done.]

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Ｇ０９Ｆ	9/00	３２８	Ｇ０９Ｆ	9/00	３２８

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(71)出願人　000003159
東レ株式会社
東京都中央区日本橋室町２丁目２番１号

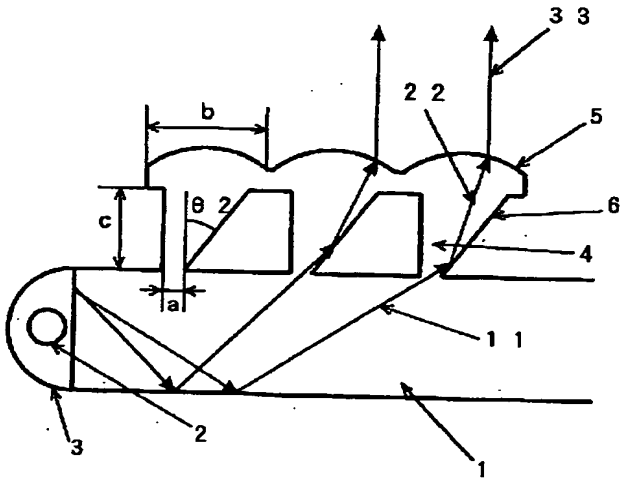
(72)発明者　内田　哲夫
滋賀県大津市園山１丁目１番１号　東レ株式会社滋賀事業場内

(72)発明者　鈴木　基之
滋賀県大津市園山１丁目１番１号　東レ株式会社滋賀事業場内

(72)発明者　三上　友子
滋賀県大津市園山１丁目１番１号　東レ株式会社滋賀事業場内

(54)【発明の名称】　指向性面状光源

(57)【要約】
【課題】効率的に光線を利用でき、薄く、均一で指向性が高く、正面輝度が極めて高い面状光源を提供する。
【解決手段】透明な導光板表面上に微小立体の配列が形成され、該導光板の少なくとも一側面に線状光源が配置された面状光源において、導光板内で全反射を繰り返して進行し、前記導光板表面に密着させた微小立体の光導入部から前記微小立体内部に取り込まれた光束のうち、少なくとも導光板表面の法線方向に対して４６～６７度の角度を有する光束が、微小立体の傾斜した壁面に於ける全反射によって導光板表面の法線方向に対して－２０～２０度の範囲内の方向に進行方向を変える前記微小立体の傾斜した壁面を有し、さらに該微小立体の光出射部にマイクロレンズを形成し、該マイクロレンズにより前記微小立体からの出射光を略平行光化するようにしたことを特徴とする指向性面状光源。



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【特許請求の範囲】

【請求項１】透明な導光板表面上に微小立体の配列が形成され、該導光板の少なくとも一側面に線状光源が配置された面状光源において、導光板内で全反射を繰り返して進行し、前記導光板表面に密着させた微小立体の光導入部から前記微小立体内部に取り込まれた光束のうち、少なくとも導光板表面の法線方向に対して４６～６７度の角度を有する光束が、微小立体の傾斜した壁面に於ける全反射によって導光板表面の法線方向に対して－２０～２０度の範囲内の方向に進行方向を変える前記微小立体の傾斜した壁面を有し、さらに該微小立体の光出射部にマイクロレンズを形成し、該マイクロレンズにより前記微小立体からの出射光を略平行光化するようにしたことを特徴とする指向性面状光源。

【請求項２】前記微小立体の傾斜した壁面の傾斜角θ２が、２０～４５度であることを特徴とする請求項１に記載の指向性面状光源。

【請求項３】前記微小立体壁面で全反射した前記光束は、マイクロレンズに達するまで、導光板表面の法線方向からマイクロレンズに入射したときの光束の進行領域内部にあることを特徴とする請求項１または２に記載の指向性面状光源。

【請求項４】前記マイクロレンズ群の配列ピッチが、２００μｍ以下であることを特徴とする請求項１～３のいずれかに記載の指向性面状光源。

【請求項５】前記微小立体が導光板と光学的に密着する光導入部の幅が、レンズ配列ピッチの１／６～１／２であることを特徴とする請求項１～４のいずれかに記載の指向性面状光源。

【請求項６】前記微小立体の高さが、前記光導入部幅の２．５～６倍であることを特徴とする請求項１～５のいずれかに記載の指向性面状光源。

【請求項７】前記微小立体を透明基板の一つの面上に配列し、マイクロレンズを該透明基板の他の面に形成したシート状部材として導光板に密着させたものであることを特徴とする請求項１～６のいずれかに記載の指向性面状光源。

【請求項８】前記透明基板が、プラスチックフィルムであることを特徴とする請求項７に記載の指向性面状光源。

【請求項９】前記プラスチックフィルムの厚みが、３００μｍ以下であることを特徴とする請求項８に記載の指向性面状光源。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は指向性面状光源に関するものである。

【０００２】

【従来の技術】面状光源は、看板、各種照明のほか、液晶表示装置用のバックライトなどとして多く用いられている。

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【０００３】一般の面状光源は、光束出射面の輝度の均一性を確保するために、ランダムに光束を拡散する種々の拡散板を用いている。このため、この出射面から出射される光束は指向性がなく、広い範囲を照射する。

【０００４】一方、面状光源の用途によっては光束の出射方向を狭い範囲に絞ることが求められる。

【０００５】例えば、液晶表示装置の用途展開の大きな妨げとなっている視野角依存性を改良する方法として、各種光拡散シートやマイクロレンズアレイシート（特開昭５３－２５３９９公報、特開昭５６－６５１７５公報、特開昭６１－１４８４３０公報、特開平６－２７４５４公報など）を液晶表示装置の観察面に装着することが提案されているが、これらの方法においては、光線利用効率や、画質（コントラストの低下や、画像のにじみ）の向上のために広がり角が３０度以下といった高い指向性を持つ背面光源が有用である。

【０００６】この目的に対して、光束の進行方向に沿ってのびる遮光壁を多数並べた、いわゆるルーバーシートが知られている。

【０００７】ルーバーシートによれば、例えば出射面において１２０度以上の広がりを持つ出射光であったものを、求める方向以外に進行する光束を遮光壁によって遮断することによって任意の指向性をもつ面状光源が得られる。

【０００８】また液晶表示装置用のバックライトとしては、消費電力に対する出射面の輝度を向上させるため、微小な三角プリズムを多数配列したプリズムシートが用いられており、これは光束の出射の方向をある程度規制することによって達成されている。

【０００９】このプリズムシートによれば、組み合わせる面状光源とプリズムの光学設計によっては６０度程度の指向性を得ることができ、正面輝度は１．５倍程度向上する。

【００１０】さらに最近では各種ゲーム機、パチンコ機などに液晶表示装置が使用されており、これら用途においては正面方向に高い輝度の光束が出射されることが望まれており、これら用途においても前記プリズムシート、またはマイクロレンズアレイシートなどによって消費電力を変えることなく、正面輝度を１．５程度上げる方法が適用されている。

【００１１】

【発明が解決しようとする課題】しかし、従来のいずれの方法においても効率的に、また面状光源の特徴である「薄さ」を損なわずに広がり角が４０度以下、さらには３０度以下といった指向性を持つ光源は得られていなかった。

【００１２】特に液晶表示装置のバックライトとして求められる、「薄さ」、光線利用効率、面内の均一性を確保したまま高い指向性を得ることはできなかった。

【００１３】ルーバーシートによれば上述したように高い指向性を得ることは可能である。しかし、ルーバーシートはシートの厚み方向にのびる遮光壁をシート内に作り込む必要があるため、その微細化には限界がある。

【００１４】このため、高い指向性を得ようとすれば、必然的に「高い」遮光壁、すなわち大きなシート厚みが必要となるという欠点がある。

【００１５】さらに、遮光壁の微細化に限界があるので、間近で目視される液晶表示装置のバックライトとしては遮光壁の配列が見えてしまい、均一性、精細性の点で問題がある。

【００１６】また、ルーバーシートの場合、求める方向以外に進行する光束を遮光壁によって吸収しているので、光線利用効率が低いという欠点がある。

【００１７】一方、プリズムシートによる方法では、高い光線利用効率が得られるが、その指向性には限界があり、上述したように６０度程度が限界であり、その輝度向上率も従来の１．５倍程度であった。

【００１８】よって、本発明は上記の欠点を解消し、効率的に光線を利用でき、薄く、均一で指向性が高く、正面輝度が極めて高い面状光源を提供するものである。

【００１９】特に、上述したような光拡散性シート（拡散板やマイクロレンズアレイシート）を液晶表示装置に装着することによって拡大された視野角をもつ液晶表示装置の光線利用効率低下、表示コントラストの低下、画像のにじみ等の問題を補償するために有効な指向性面状光源や、ゲーム機、パチンコ機等の正面方向のみから観察される液晶表示装置用として、低消費電力、高正面輝度の指向性面状光源を提供するものである。

【００２０】

【課題を解決するための手段】本発明は上記の課題を解決するため以下の構成としたものである。

【００２１】すなわち、本発明は、透明な導光板表面上に微小立体の配列が形成され、該導光板の少なくとも一側面に線状光源が配置された面状光源において、導光板内で全反射を繰り返して進行し、前記導光板表面に密着させた微小立体の光導入部から前記微小立体内部に取り込まれた光束のうち、少なくとも導光板表面の法線方向に対して４６～６７度の角度を有する光束が、微小立体の傾斜した壁面に於ける全反射によって導光板表面の法線方向に対して－２０～２０度の範囲内の方向に進行方向を変える前記微小立体の傾斜した壁面を有し、さらに該微小立体の光出射部にマイクロレンズを形成し、該マイクロレンズにより前記微小立体からの出射光を略平行光化するようにしたことを特徴とする指向性面状光源である。

【００２２】

【発明の実施の形態】本発明の指向性面状光源とは、指向性の持った光束を観察面側に出射する面状光源のことをいう。

【００２３】ここでいう指向性とは、面状光源から出射される光束の進行方向の揃っている程度をいい、ここではその尺度として、最も高い輝度が観察される方向を中心として、その最大輝度の１／２の輝度が観察される立体角のはさみ角を指向角と表すものとする。

【００２４】本発明の目的とする指向性は、光束の出射方向が法線方向付近であり、その指向角が４０度以下、さらには２０度以下、さらには１０度以下という高い指向性をもつものである。

【００２５】さらに本発明の指向性面状光源は、マイクロレンズにより導光板から出射される光束を絞り込むため、従来の面状光源に比べて極めて高い正面輝度が得られる。この場合、従来の面状光源に使用されている光源をそのまま使用するため、消費電力が高くなることはない。本発明の指向性面状光源で得られる正面輝度は従来の面状光源に比べて３倍以上、さらには４倍以上、さらには５倍以上という極めて高いものである。

【００２６】面状光源に指向性を付与する方法としては、前述したようにルーバーシートやプリズムシートを用いることが知られているが、本発明の指向性面状光源はマイクロレンズ群により指向性を付与することを概念とするものであり、以下模式図を使って本発明を具体的に説明する。

【００２７】本発明の指向性面状光源は、図１のように透明な導光板１の側面に線状光源２を配置したいわゆるエッジ式面状光源である。

【００２８】ここでいう導光板１とは、透明なプラスチック板のことをいい、アクリル樹脂板、ポリカーボネート板、エポキシ樹脂板などで代表されるものであり、導光板の形状は平板型、くさび型などに調整される場合が多いが、光線経路調整のしやすさから本発明では平板型のものが好ましく使用される。また、該導光板１の厚みは１０mm以下、さらには５mm以下であることが、薄型、軽量という点から好ましい。

【００２９】またここでいう線状光源２とは、特に限定されるものではなく、例えば冷陰極あるいは熱陰極の蛍光ランプなどが挙げられ、該蛍光ランプの周りを反射率の高い反射板（リフレクタ）３で囲み、導光板１側面から内部へ効率良く光束を入射させることが好ましい。本発明で該線状光源２の配置位置は特に限定されるものではなく、導光板１の１側面に配置する１側面配置型、またその反対側の側面にも配置した平行２側面配置型、さらには１側面とその側面に垂直した側面にも配置したＬ字型２側面配置型、さらには全て（４側面）に配置された４側面配置型などいずれでもよい。

【００３０】ここで線状光源２から発せられ導光板１の側面から導光板１内部に侵入する光束のうち、導光板１を構成する樹脂と周囲（基本的には空気）との屈折率差に基づく臨界反射角を超える光束１１は、導光板１と空気との界面で全反射を繰り返す。ここで臨界反射角θは

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次式で求められる。

【００３１】$\theta = \sin^{-1}(n1/n2)$

ｎ１：周囲の屈折率（空気の場合１．０）

ｎ２：導光板の屈折率

この臨界反射角は導光板１を構成する材料、周囲の物質によって変化し、例えば導光板がアクリル樹脂（屈折率＝１．４９）、周囲が空気である場合、臨界反射角θは約４２度となる。このような条件である場合、導光板１内の光束のうち導光板１と空気との界面に当たる光束の角度θ１が臨界反射角４２度を超える光束は全て全反射し、導光板１表面が平滑でかつ平板状である場合、このθ１が変化することはなく、導光板１内で全反射を繰り返すこととなり、導光板１表面から光束が出射することはない。

【００３２】このようなことから、導光板１がアクリル板の場合、導光板１内を進行する光束は導光板１の法線方向に対して４２度～９０度の角度で進行しており、また本発明者らによればその中でも４６～６７度の角度を有する光束が最も強い。

【００３３】また本発明の指向性面状光源は、図２のように、導光板１上に微小立体４を形成させ、前記導光板１内で全反射を繰り返す光束１１の一部を光導入部から微小立体４内部に取り込み、このうち少なくとも前記導光板１内を４６～６７度の角度で進行する強い光束を一度微小立体の壁面で全反射させ、導光板表面の法線方向に対して－２０～２０度の範囲内に進行方向を変化させ、さらにこの全反射した光束２２を個々の微小立体４上に形成されたマイクロレンズ群を構成する単位レンズ５により絞り込み、導光板１表面から指向化された光束３３として略平行化させるものである。

【００３４】本発明に用いられるマイクロレンズ群を構成する単位レンズ５は、図３のように凸レンズであり、マイクロレンズ群形成面の法線方向から単位レンズ５に入射した平行光４４は集光され、最も光束密度が密になる集光点８（１次元マイクロレンズ群の場合は集光線）を通過したのち、拡散しながら進行する。

【００３５】逆から見れば、前記集光点８側から入射する（発せられる）光束のうち、該光束経路と前記平行光の集光経路と一致あるいは近似した光束５５は、単位レンズ５により指向化された光束３３として略平行化、すなわちレンズ配列面の法線方向に出射される。

【００３６】本発明の指向性面状光源を構成する微小立体および微小立体の理想形状を図４を用いて説明する。

【００３７】導光板１から微小立体４に取り込んだ光束を、微小立体４壁面で全反射させるために、少なくとも線状光源２から発せられ導光板１内に侵入、進行する光束１１が微小立体４内部に取り込まれたとき、一番最初に到達する微小立体４の壁面、すなわち微小立体４の線状光源２からみて遠い面に傾斜がつけられる。このとき傾斜させる方向は、線状光源２から見て遠い方向に傾斜させるものである。また面６は線状光源２と平行であることが光利用効率の点から好ましい。

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【００３８】前述した導光板１内を４６～６７の角度で進行する強い光束を前記面６で有効に全反射させ、全反射後の進行方向を導光板表面の法線方向に対して－２０～２０度の範囲に変えるため、微小立体４の面６の傾斜角θ２は２０～４５度、さらには２５～３５度とすることが好ましい。傾斜角θ２が前記範囲未満では導光板１内を進行する４６～６７度の強い光束のうち深い角度の光束は面６で全反射することができず、該面６を透過してしまい、対応する単位レンズ５に光束が到達しないため、指向性が大幅に低下する。また前記範囲を超えると逆に浅い角度の光束を面６で全反射することができなくなるため好ましくない。さらに前記範囲から大きくはずれると、全反射後の光束経路が導光板の法線方向からずれるため好ましくない。

【００３９】またこの微小立体４の面６の傾斜角θ２は、均一な角度である必要はなく、例えば傾斜角が異なる２面以上の面、あるいは曲面状であっても構わない。面６が曲面状である場合、本発明ではその傾斜角θ２は曲面の接線の角度で表すものとする。このような面６が異なる傾斜角を有する複数の面が存在する場合は、導光板と微小立体の界面に近い面の傾斜角を大きくし、高さ方向に対しその角度が小さくなるように調整することが好ましい。このような調整とすることで、前記４６～６７度の強い光束のみならず、それ以上の角度で導光板から微小立体内部に取り込まれる光束をも前記大きい傾斜角面で一度全反射させ、この全反射した光束を小さい傾斜角面で反射させることにより、高い光利用効率とすることができる。

【００４０】本発明の指向性面状光源を構成するマイクロレンズ群の単位レンズ５の幅ｂは１８０μｍ以下であることが好ましく、その配列ピッチは２００μｍ以下であることが、均一性、精細性などの点から好ましい。

【００４１】また微小立体４と導光板１の密着部分、すなわち光導入部の幅ａは、単位レンズ幅ｂの１／６～１／２、さらには１／５～１／３であることが好ましい。該光導入部幅ａが前記範囲未満では導光板１内を進行する光束１１を微小立体４内部に取り込む光量が小さすぎるため、指向性面状光源とした場合、十分な輝度が得られないため好ましくない。また前記範囲を超えると、導光板１から微小立体４内部に取り込む光量が大きすぎるため、指向性面状光源としたとき、線状光源２に近い部分は極めて高い輝度が得られるが、線状光源から遠い部分は低輝度となりやすくなるばかりか、導光板１から取り込んだ光束を前記面６で全反射する光量が減るため好ましくない。

【００４２】さらに本発明の微小立体４の高さｃは、前記光導入部幅ａの２．５～６倍、さらには３～５倍であることが好ましい。微小立体４の高さｃが前記範囲未満

では、導光板１から微小立体４内部に取り込んだ光束の前記微小立体４の面６で全反射する光量が減ってしまい、指向性面状光源としたとき十分な指向性が得られないため好ましくない。また前記範囲を超えると指向性面状光源としたときに全体の厚みが厚くなりすぎるため好ましくない。

【００４３】このような微小立体形状とすることで、導光板１から微小立体４内部に取り込んだ光束の大半を、前記面６で全反射させ進行経路を調整することが可能となる。この全反射させる光束の光量は、導光板１内を４６～６７度の角度で進行している光束を取り込んだ光量の７０％以上、さらには８０％以上、さらには９０％以上であることが光の利用効率の点から好ましい。

【００４４】本発明の指向性面状光源の微小立体上に形成されるマイクロレンズ群を構成する単位レンズ５は、図６のように、前記面６で全反射した光束、すなわち導光板１内から４６～６７度の角度でシート内部に入射し、前記面６で全反射し導光板の法線方向の－２０～２０度に進行方向が変えられた光束が、単位レンズ５に到達するまでに、導光板１の法線方向からマイクロレンズに入射したときの光束４４の進行領域内部（図６に示す斜線部分Ａの領域）に位置するように調整することが好ましい。単位レンズ形状、配列位置が前記条件を満たさない場合は指向性が低くなるため好ましくない。

【００４５】本発明の指向性面状光源を構成する微小立体あるいはマイクロレンズ群を導光板上に形成させる方法としては、所望の微小立体、マイクロレンズパターンが刻印された雌型金型あるいは樹脂型を用意し、ついで該型中に透明な熱硬化性あるいは紫外線、電子線硬化性樹脂を充填し導光板上に合わせ、該樹脂を硬化せしめる方法のほかに、図５のように微小立体、マイクロレンズ群をあらかじめ透明基板７上に形成させ微小立体と導光板を光学的に密着せしめる方法も好ましく適用される。このような方法を適用する場合、微小立体は幅の狭い方を上にして透明基板上に形成され、透明基板の微小立体が形成された面の反対側の面にマイクロレンズ群を形成し、微小立体頂部を導光板と密着後透明基板を剥離してもよいがそのままでもよい。

【００４６】本発明で使用される透明基板は、機械的強度等の点からプラスチックフィルムであることが好ましく、さらにはその厚みが３００μｍ以下であることが薄型という点で好ましい。

【００４７】本発明の指向性面状光源を構成する微小立体は、線状光源を配置する位置により微小立体の形状、配列状態が調整され、導光板側面に配置された線状光源と平行な位置に前述した微小立体傾斜面（面６）が配列される。線状光源が１側面あるいはその側面に平行なもう一つの側面（２側面配置）に配置された場合は１次元配列あるいは２次元配列、Ｌ字状、４側面に線状光源が配置された場合は２次元配列が取られる。なお、微小立体の１次元配列とは、カマボコ状レンズ（いわゆるシリンドリカルレンズ）等が形成されたもので、左右あるいは上下一方向のみにレンズとして機能するものであり、２次元配列とは、ドーム状等の形状にレンズが形成されたもので、少なくとも上下、左右の２方向に対し、レンズとして機能するものである。

【００４８】

【実施例】以下、本発明を実施例に従って詳しく説明するが、これに限られるものではない。

【００４９】実施例１～３

厚み３８μｍのポリエステルフィルム（“ルミラー”東レ（株）製）の一面に、求める形状が刻印された金型にアクリル系紫外線硬化型樹脂（屈折率１．５０）を充填し紫外線を照射、金型を剥離することで図６（形状）、表１（寸法）のような微小立体を１次元配列した。この中で実施例１～３については、同じく求める形状が刻印された金型に紫外線硬化型樹脂を充填し、紫外線照射、金型剥離することで微小立体の反対側の面に、図６、表１に示した集光点距離の単位レンズが配列されたマイクロレンズ群を形成させた。このとき該マイクロレンズ群を構成する単位レンズのレンズ形成面側から入射する平行光の集光経路が、微小立体の傾斜面に当たるように位置合わせを行った。

【００５０】次に厚み４ｍｍ、縦６７ｍｍ横８１ｍｍの平板型のアクリル樹脂板を用意し、以下線状光源が配置される側面と、前記微小立体の傾斜面６が平行となるようにして、微小立体頂部をアクリル樹脂板表面に光学的に密着させることで、本発明の実施例および比較例の導光板を作成した。

【００５１】比較例１、２

従来の面状光源として、前記アクリル板表面にマット加工を施した導光板上に拡散板をのせた従来の面状光源を比較例１、その上にさらにプリズムシートをのせたものを比較例２として用意した。

【００５２】［光学特性評価］前記導光板の一側面に線状光源（２Ｗ蛍光ランプ使用）を配置し他の側面には反射板を装着し、導光板の法線方向を０度とし線状光源が配置された方向をプラス（＋）、その反対側をマイナス（－）とし出射される光束の角度別輝度を測定し、最大輝度が観察される角度（ピーク角）、最大輝度、指向角を表２に示した。

【００５３】表２本発明の実施例の導光板を用いた面状光源は従来のものに比べ、正面輝度、指向性が極めて高いことがわかる。

【００５４】

【表１】

	a (μm)	b (μm)	c (μm)	d (μm)	θ2 (deg)	ﾚﾝｽﾞ集光点距離(μm)
実施例1	10	60	30	27	30	60
実施例2	5	30	15	14	33	30
実施例3	10	62	40	38	35	75

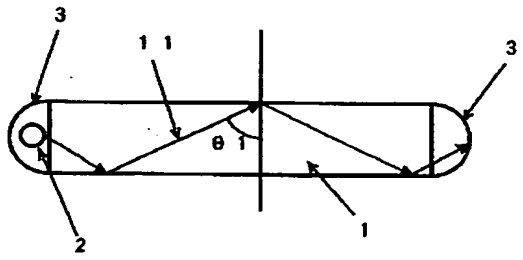
【表２】

	ピーク角 (deg)	最大輝度 (cd/㎡)	指向角 (deg)	備考
実施例1	2	12300	4	
実施例2	0	12000	6	
実施例3	0	13200	4	
比較例1	13	1800	60<	従来品
比較例2	6	2300	62	従来品／ﾌﾟﾘｽﾞﾑｼｰﾄ装着

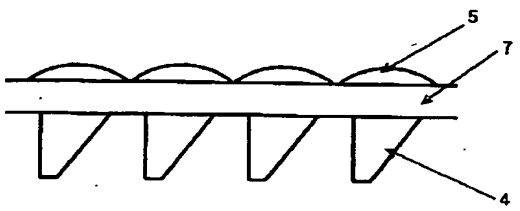
【００５５】
【発明の効果】従来の面状光源の消費電力をあげることなく効率的に光線を利用することで、薄く、均一で高指向性、高正面輝度の面状光源を提供することができ、特に光拡散性シート（拡散板やマイクロレンズアレイシート）を液晶表示装置に装着することによって拡大された視野角をもつ液晶表示装置の、正面輝度低下、表示コントラストの低下、画像の滲み等の問題を補償するために有効な指向性面状光源を提供できる。
【００５６】さらには正面方向からの観察する場合が多い液晶表示装置、例えばパソコン、カーナビ、ゲーム、パチンコ向けの液晶表示装置に有効な低消費電力で正面輝度の高いの指向性面状光源を提供できる。
【図面の簡単な説明】
【図１】指向性面状光源の一例を示す概略図である。
【図２】本発明の指向性面状光源の一例を示す概略図である。
【図３】本発明の指向性面状光源を構成するマイクロレンズ群の一例を示す説明図である。
【図４】本発明の指向性面状光源の他の一例を示す説明図である。
【図５】本発明の指向性面状光源の作成法の一例を示す説明図である。
【図６】本発明の実施例および比較例に用いた微小立体の形状の模式図である。

【符号の説明】
１：導光板
２：線状光源
３：リフレクター
４：微小立体
５：単位レンズ
６：微小立体壁面
７：透明基板
８：単位レンズにレンズ形成面側から入射する平行光の集光点
ａ：光導入部分幅
ｂ：単位レンズ幅
ｃ：微小立体高さ
ｄ：微小立体幅
ｅ：単位レンズにレンズ形成面側から入射する平行光の集光点距離
１１：導光板内を進行する光束
２２：微小立体壁面全反射した光束
３３：マイクロレンズにより指向化された光束
４４：マイクロレンズ形成面側から入射する平行光
５５：４４光の集光点側からマイクロレンズに入射する光束
θ１：導光板内を進行する光束の角度
θ２：微小立体と空気との界面６の傾斜角

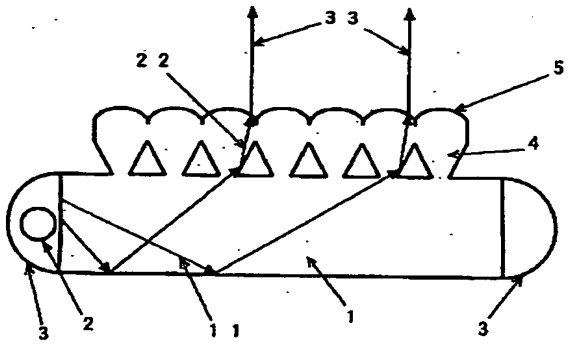
【図１】



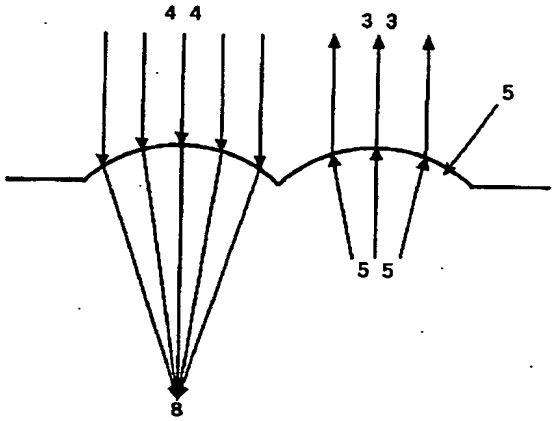
【図５】



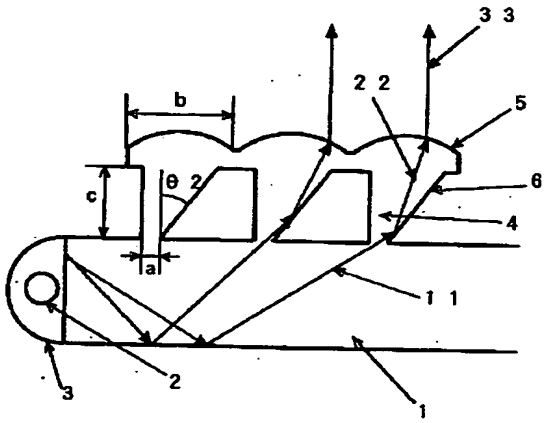
【図２】


3 3
2 2
5
4
3
2
1 1
1
3

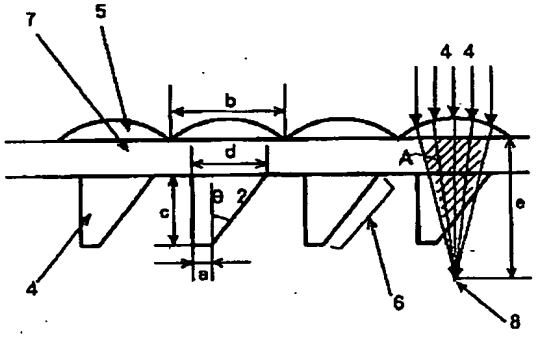
【図３】


4 4
3 3
5
5 5
8

【図４】


3 3
2 2
b
5
6
θ 2
c
4
a
1 1
3
2
1

【図６】


7
5
4 4
b
d
A
θ 2
c
e
a
4
6
8